AFHRL-TR-78-38

(3) LEVEL II

AIR FORCE HUMAN RESOURCES LABORATORY

DDC FILE COPY AD A060222

EFFECTIVENESS OF ADAPTABILITY SCREENING

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August 1978
Interim Report for Period October 1977 – April 1978

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFHRL-TR-78-38	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): EFFECTIVENESS OF ADAPTABILITY SCREENING	5. TYPE OF REPORT & PERIOD COVERED: Interim rept. Oct [illegible] - Apr [illegible]78
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): Nancy Guinn, Jeffrey E. Kantor, Bart M. Vitola	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Personnel Research Division, Air Force Human Resources Laboratory, Brooks Air Force Base, Texas 78235	10. PROGRAM ELEMENT, PROJECT, TASK, AREA & WORK UNIT NUMBERS: 62703F, 77190251
11. CONTROLLING OFFICE NAME AND ADDRESS: HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235	12. REPORT DATE: Aug [illegible]78
	13. NUMBER OF PAGES: 18
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

SM Study Number 6667

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

adaptability
attrition
high-risk personnel
unsuitability
undesirable losses
maladaptive accession

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A total of 12,599 basic airmen on whom aptitudinal, biographical, and History Opinion Inventory (HOI) data were collected comprised the sample population. Using the successful completion of first-term of military service as the criterion, regression analyses were accomplished to determine the effectiveness of various experimental predictor composites. Efforts were made to develop the most economical composite from the standpoint of number of data items required while retaining the maximum amount of predictive accuracy. Multiple correlations of the two composites developed from these analyses were .43 and .49. Cross-application analyses resulted in multiple correlations of .43 and .47. The effectiveness of the composites were compared to the screening effectiveness of the 1972 and 1975 standards for enlistment. Problems related to the implementation of such a screening procedure were discussed.

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

404 425

PREFACE

This research was conducted under Project 7719, Selection and Classification Technology; Task 771902, Methods for Increasing Effectiveness of Personnel Programs.

Appreciation is expressed to Mr. Jim Friemann and Senior Airman Stanley E. Prescott (Computational Sciences Division, AFHRL) for their technical competence and valuable assistance in computer programming and accomplishment of desired analyses.

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I. INTRODUCTION

Over 50% of the Department of Defense (DOD) budget is allocated for personnel costs. These costs include the procurement, training, selection, separation, and retirement of personnel, both military and civilian, in the DOD. One portion of military costs, those associated with separation of personnel prior to completion of their normal obligated tour, represents a sizable expenditure which might be avoided if personnel not likely to adapt to the military environment could be identified prior to enlistment. Numerous studies in all the services indicate that a certain proportion of these high-risk individuals can be identified prior to entry onto active duty (Arthur, 1971; Bucky & Edwards, 1974; Erwin & Herring, 1977; Flyer, 1963; Plag & Goffman, 1966; Sands, 1977; Shoemaker, Drucker, & Kriner, 1974; Yellen, 1975); however, in identifying these individuals, a large number of individuals who would be successful are mislabeled as high-risk. These refined selection techniques might well be useful when there is a surplus of individuals wanting to enter service, but the utility of screening becomes doubtful when the manpower pool from which the armed services must procure personnel to fill operational requirements is shrinking. In addition, the propensity to enlist in the services has declined significantly from the fall of 1975 through the fall of 1977 (Market Facts, Inc., 1978). Research is now focusing on the prediction of attrition-prone individuals with more precise selection instruments to differentiate more accurately between the would-be "leavers" from the "stayers."

In 1972, Air Force medical personnel developed a screening inventory which was found to have predictive utility in identifying recruits likely to have problems in adaptation to the military environment (LaChar, Sparks, & Larsen, 1974). This instrument, the History Opinion Inventory (HOI), is a 100-item self-report inventory designed to tap dimensions of school adjustment, family stability, social orientation, emotional stability, bodily complaints, motivation and expectations for achievement, and response toward authority. Follow-on research by the Air Force Human Resources Laboratory indicated that this instrument, along with aptitudinal and demographic data, was moderately effective in the prediction of involuntary separations at the 2-year point of an individual's first term. Based on these results, it was concluded that substantial savings might be realized by using this screening device to identify maladaptive personnel (Guinn, Johnson, & Kantor, 1975).

The present study continues the assessment of the utility of the HOI in predicting separations during the first term and the development and validation of screening composites to identify individuals most likely to attrit during the initial 4-year term. The primary objectives of the study were: (a) to follow up the accessions administered the HOI in basic military training to determine the accuracy of the inventory and subsets of inventory items in predicting the criterion of first-term attrition; and (b) to evaluate whether the additional aptitudinal and biographical data might increase the overall effectiveness of the screening procedure.

II. METHOD

Complete aptitudinal, biographical, and inventory data were available for a total of 12,599 basic airmen who were administered the HOI during basic military training at Lackland AFB, Texas, from June to August 1972.

The data files of these individuals were matched with the airman retention and loss files maintained by the Computational Sciences Division of the Air Force Human Resources Laboratory to obtain criterion data. Table 1 indicates the final disposition of the sample population at completion of their initial tour by discharge group. Discharge status was determined by a loss code which identified personnel who had been separated prior to completion of the first term from those who reenlisted or had been eligible to reenlist but elected to leave service. Loss codes

Table 1. Criterion Groups

Criterion Group Number	Criterion Group Description	Description of Loss Codes Included in Criterion Group		Number of Individuals in Group
1	In service	Active duty personnel (Reenlisted or extended)		3,916
2	Loss, normal separations	Separated from service after completion of normal tour; eligible to reenlist		3,142
3	Loss, undesirable			3,167
		A. Marginal productivity Inaptitude Minimally productive Unsuitability-apathy Unsuitability-shirking	998	
		B. Disqualified for retention Failure to meet minimum standards for retention	1,398	
		C. Unfitness Unfitness-discreditable behavior Misconduct-civil court action Desertion-AWOL Court-martial Preservation of good order/discipline Failure at prisoner retraining/ rehabilitation	245	
		D. Unsuitability Unsuitability Drug/alcohol abuse Substandard personal behavior Personality disorder Character and behavior disorder Sexual deviation Enuresis Unsuitability-general inadaptability Unsuitability-aberrant tendencies	420	
		E. Miscellaneous undesirable Conscientious objector Fraudulent enlistment Financial irresponsibility Good of the service Misc-ineligible to reenlist	106	
4	Loss, Officer program	Released to enter officer training		58
5	Loss, Desirability Indeterminate	Death Educational release Non-fulfillment of enlistment guarantee Personal reasons Hardship Erroneous enlistment Convenience of the Government		1,915
6	Loss, physical reasons	Obesity Physical retirement Physical problems, EPTS Physical problems, attrition Physical problems, PETS/Medical standards		401
		Total		12,599

were grouped based on similarity of discharge reason. Each individual, based on his final disposition code, was assigned to one of the following mutually exclusive categories:

1. In service: A total of 3,916 individuals in the sample population had reenlisted after their 4-year commitment or had extended their original commitment and were still on active duty at the completion of their normal 4-year tour.

2. Loss, normal separation: This group consisted of 3,142 individuals who elected to leave service at the end of their military commitment but were eligible to reenlist.

3. Loss, undesirable: A total of 3,167 individuals were separated from service for reasons of undesirability. This group includes personnel with several types of discharge: those demonstrating marginal ability, apathy, defective attitude, and inability to expend effort constructively; those exhibiting character/behavior/personality disorders, drug/alcohol abuse, and/or sexual deviation; those failing to meet minimum standards for retainability; those with disciplinary problems; and finally, those who were ineligible to reenlist for miscellaneous undesirable reasons.

4. Loss, officer program: This group of 58 individuals was released to enter an officer training program.

5. Loss, desirability indeterminate: A group of 1,915 individuals included losses from service such as those for personal reasons, hardship, death, etc. The desirability or undesirability of these cases could not be definitively ascertained from the discharge code.

6. Loss, physical reasons: A total of 401 individuals received discharge codes indicating that their separation was based on a physical disability.

Certain final disposition categories were combined for analysis purposes. Groups 1, 2, and 3 comprised the criterion group which was used in the primary development and validation of a selector composite. Although this criterion group was used for the majority of analyses, results were then applied to the total sample to show the effectiveness of the composites on a heterogeneous population that more nearly approximates a normal entry population. Table A1 in the appendix presents descriptive statistics on all disposition groups in the sample population.

Multiple linear regression analyses (Bottenberg & Ward, 1963) were accomplished to determine the usefulness of the predictor variables in identifying maladaptive personnel. Variables used in these analyses are listed in Table 2. For each individual in the sample population, biographical and aptitudinal variables available at time of enlistment were taken from the airman record files. HOI inventory response data were included as individual predictors. In addition to the separate HOI items, 33 of the HOI items were compiled into the Military Services Inventory (MSI) scale. The MSI scale as well as the individual items in the HOI were then used in developing screening composites.

Based on the results of the regression analyses, an effort was made to select an optimal set of predictors to be used in an operational setting. Attention was directed toward maximizing the predictive accuracy and minimizing additional testing time which would be required to implement the screening technique.

To determine the stability of the results, the undesirable sample was subdivided into validation and cross-application half samples. An equal number of each type of disposition category was included in each half sample.

III. RESULTS AND DISCUSSION

Biographical, attitudinal, and inventory variables were combined into four different experimental selector composites and tested for statistical significance. A delineation of the variables included in each model is presented in Table 3. All models were found to be statistically significant at or beyond the .01 level.

In developing a selection composite for operational use, various aspects of the proposed system must be considered prior to recommending the screening technique for implementation. An evaluation must be made of the potential savings which might be accrued by the identification and rejection of eliminees against the additional cost in time and money required to implement the proposed screening system. In addition, with the projected downward trend in the number of 18-year-olds available from the potential applicant pool in the 1980's, the number of individuals

Table 2. **Variables Used in Regression Analyses**

A. Predictor variables

Aptitudinal and biographical data[a]

- Mechanical Aptitude Index
- Administrative Aptitude Index
- General Aptitude Index
- Electronics Aptitude Index
- AFQT score
- High school courses
  - speech
  - algebra
  - basic electronics
  - biology
  - bookkeeping
  - business math
  - chemistry
  - art
  - drafting
  - general science
  - geometry
  - journalism
  - photography
  - physics
  - psychology
  - print shop
  - radio repair
  - trigonometry
  - use of blueprints
  - anatomy
  - auto repair
  - book binding
  - social science
  - English
  - industrial arts
  - logarithms
  - general business
  - business law
  - driver training
  - geography
  - management
  - marketing
  - mech/tech theory
  - merchandising
  - home economics
  - business machines
  - statistics
  - general math
  - shop math
  - vocational guidance
- Marital Status
- Number of Dependents
- Age
- Years of education
- Age -- squared
- Years of education -- squared
- PUHLEN
  - stamina
  - upper extremities
  - lower extremities
  - hearing
  - eye sight
  - neuropsychiatric

Additional test data[b]

- History Opinion Inventory (HOI) -- 100 items
- Military Services Inventory scale -- scored subset of 33 HOI items

B. Criterion variable

- Eligible/Ineligible to Reenlist

[a] These data are retrievable from airman record files

[b] These data elements were obtained by additional testing.

Table 3. **Summary of Regression Analyses**

Full Model[a]		Restricted Model		F Ratio
Model A	.2459	Model 0	.0000	10.22*
Model B	.1872	Model 0	.0000	19.72*
Model C	.2452	Model 0	.0000	13.28*
Model D	.1872	Model 0	.0000	19.22*
Model A	.2459	Model D	.1872	3.86*

[a]Model description: *Model A* – Includes all aptitudinal and biographical data and HOI items. *Model B* – Includes all aptitudinal and biographical data and MSI scale score. *Model C* – Includes all aptitudinal and biographical data and optimal subset of HOI items. *Model D* – Includes all aptitudinal and biographical data and HOI items which comprise MSI scale score.

*.01 level.

identified as eliminees who, in fact, would be successful becomes a matter of important concern. Therefore, attention must be directed toward these realistic constraints in assessing the practical utility of the proposed screening composites. For these reasons, various configurations of the selector composite model were studied in an effort to minimize the length of the test, as well as the number of personnel who might be incorrectly identified by the screening system.

For the first step in reducing the overall length of the screening composite, Model B containing the MSI 33 items was compared to Model A containing all the HOI items to see if the shorter subset was as efficient in predicting attrition as the total inventory. Results of comparing these two models indicate the additional HOI items do make a unique and significant contribution over and above the 33-item MSI scale alone. From a statistical standpoint, Model A which requires all 100 items of the HOI is the better model. From a practical standpoint, Model B requiring only an additional test of 33 items appears quite effective. Therefore, although the longer HOI inventory indicated statistical superiority over the shortened subset of items included in the MSI scale, Model B containing the 33-item MSI scale, due to its greater efficiency in test administration time, was included in all subsequent analyses.

Additional analyses were directed toward reducing the overall length of Model A by identifying the minimum number of variables which could be used without significantly lowering the predictive accuracy of the screening composite. In accomplishing these analyses, additional constraints were imposed on the computational process which would more nearly reflect the actual operational environment. For instance, certain aptitudinal and biographical data are routinely collected on incoming accessions and placed in permanent record files at the time of enlistment. The use of these data would entail no extra cost to the Air Force in additional testing time. Therefore, in the development of an optimal number of predictors including HOI response data, the available aptitudinal and biographical data on all enlistees were used as the basic components in the predictor system. After these data were included in the predictor composite, all other HOI items were considered for inclusion in the final composite if they made a unique and significant contribution. The final composite Model C included a total of 122 variables, 64 of which were HOI items. The reduction of 36 items from the original HOI without any significant reduction in predictive accuracy appears worthwhile.

The multiple correlations for Models B and C were .43 and .49, respectively. Upon cross-application, the obtained correlations (.43 for Model B, and .47 for Model C) retained statistical significance. These data are shown in Table 4. It should be noted that the correlations are somewhat lower than if they had been computed on a population not restricted by initial enlistment screening.

Table 4. **R^2 and Multiple Correlations – Validation and Cross-Validation Samples**

	Model B		Model C	
Sample	R^2	R	R^2	R
U1 (Validation Sample)	.1872	.4327*	.2452	.4952*
U2 (Cross Application Sample)	.1828	.4276*	.2246	.4739*

*Significant at beyond .01 level.

Based on these results, it appears that both Models B and C would be useful as a screening technique to identify personnel who might be

maladaptive during their 4-year tour. However, the overall statistical significance of a predictor composite often fails to reflect its practical utility. Table 5 shows the comparative efficiency of Models B and C by the percentage of personnel correctly and incorrectly identified by the composites. The hit rate (those correctly identified as successfully completing their first-term and those correctly identified as premature separations) for Model C is higher. Model C correctly identifies 77% in the total undesirable criterion group and 66% of the individuals in the total sample population which includes all types of losses. Applying the screening composites to the total sample was done to show the utility of the screening techniques on a population which more nearly reflects a representative input population than a sample population which excludes all losses other than undesirable ones. A major drawback of Model C is that it screens out approximately 11% of the total population who would have successfully completed their first-term. Recruiting efforts would have to be increased to reach required production goals. When only the personnel successfully completing their initial tour are considered, the models appear quite similar. However, the 17%/19% of successful personnel screened out by these techniques appears somewhat expensive from a manpower standpoint. It is encouraging to note that over a third of those personnel who did not complete their original tour would have been identified as maladaptive.

A valid assessment of these potential screening composites is made more difficult by the fact that since the 1972 sample entered service, enlistment standards have become more stringent. Since 1975, accessions must meet three criteria: (1) Each individual must obtain a total score of 170 or higher on the four combined aptitude indexes of the Armed Services Vocational Aptitude Battery; (2) Their General Aptitude Index score must be 45 or higher; and (3) If they receive a mental

Table 5. **Comparative Efficiency of Experimental Enlistment Standards**

Basis for Comparison	Total Sample[a]		Undesirable Criterion Sample[b]	
	Model B	Model C	Model B	Model C
Total Sample				
Percentage of eligible/ineligible personnel correctly identified (hit rate)	64	66	75	77
Percentage of eligible personnel incorrectly identified as potential losses (false positive rate)	9	11	7	7
Percentage of losses incorrectly identified as eligibles (miss rate)	27	23	18	16
Eligible Personnel[c]				
Percentage identified as eligible	83	81	90	90
Percentage identified as potential losses	17	19	10	10
Ineligible (Loss) Personnel[d]				
Percentage identified as losses	39	48	41	47
Percentage identified as eligible	61	52	59	53

[a] Includes all criterion groups.

[b] Includes only active, normal separations, and loss, undesirable criterion groups.

[c] Includes personnel in active and normal separations criterion groups.

[d] Includes personnel who were identified in a loss group.

classification of Category III or IV on the Armed Forces Qualification Test, they must have completed high school. To give some indication of the relative effectiveness of these selector composites under current enlistment standards, Table 6 shows the percentage by disposition groups by enlistment standard. The original population entered under 1972 enlistment standards which, in general, required a prospective recruit to qualify with an aptitude score of 40 on one of the four aptitude indexes. Imposing the more stringent 1975 standards to the sample population would have reduced the input population by 24%. With this standard, 31% of the undesirable losses would have been rejected from initial enlistment, but 19% of the eligible-to-reenlist population would also have been rejected. Model B would have rejected an even larger percentage of the undesirable/ineligible group (51%) and a smaller percentage of eligibles (17%). It appears that Model C would have been even more effective in identifying losses but would have screened out the same percentage of eligibles as the 1975 standard. It appears that the use of either selector composite would have been as effective as the 1975 standard. When these models are applied in addition to the 1975 standard, the screening of all types of attritions becomes more effective but a larger loss of eligibles is also experienced. Other factors must be considered in applying a screening technique such as the effect of a particular standard on quality or the impact of the standard on the racial composition of the force. Tables 7 and 8 present data on these factors. Table 7 shows the effect of the various standards on aptitude and educational level. In general, application of the 1975 standard on the 1972 population raises the overall aptitude level somewhat higher than does either Model B or C. The double standard of 1975 with either Model B or C raises the aptitude level slightly from the 1975 standard alone.

From Table 8, it appears that the use of the 1975 standard changes the racial composition of the 1972 sample slightly. Both Models B and C appear to more nearly reflect the 1972 racial composition than does the 1975 standard. Adding either Model B or C to the 1975 standard produces little or no change in racial composition from the 1975 standard alone.

IV. CONCLUSIONS AND RECOMMENDATIONS

In general, the value of implementing any screening procedure based on biographical, aptitudinal, or inventory data must be carefully evaluated by considering the savings which would be accrued by early identification of high-risk personnel versus the loss to the Air Force of potentially successful personnel who might be denied the opportunity to enlist. When the quantity and quality of the prospective recruit applicant pool are high, a screening methodology can be quite cost-effective in saving the expenses of procuring, selecting, training, and replacing personnel by identifying maladaptive personnel before entry onto active duty. Although these savings may be attenuated by the loss of potentially productive personnel at the same time, in a good recruiting environment such a procedure would be justified. However, if it becomes difficult to enlist the required number of recruits to fulfill Air Force manning requirements, the loss of potentially successful personnel identified as maladaptive becomes a critical issue for evaluation.

The screening composites comprised of aptitudinal, biographical, and inventory data appear to indicate that a preliminary screening device can be effective in the identification of high-risk personnel. However, overall savings from early identification of high-risk groups might be diminished by the costs of implementing a secondary assessment procedure which must be administered to all potential recruits.

Further ongoing research will provide factual data on issues related to the operational use of such a screening procedure. The effectiveness of this screening procedure with the female population is now being evaluated. In addition, a group of 1977 accessions is being tracked to provide more current data on the effectivness of this procedure and provide a better basis for an operational implementation decision.

Table 6. **Percentage Qualifying and Screened by enlistment Standards – 1972 Sample Population**

Enlistment Standard		Eligible to Reenlist			Ineligible to Reenlist						Other			Total Sample
		Active Duty	Normal Separations	Total Eligible	Loss, Marginal Prod	Loss, Disqual for Retn	Loss, Unfit-ness	Loss, Unsuit-ability	Loss, Misc Undes	Total Undes Inelig	Loss, Officer Program	Loss, Desir Indetm	Loss, Physical Reasons	
1972	N	3,916	3,142	7,058	998	1,398	245	420	106	3,167	58	1,915	401	12,599
	%	31	25	56	8	11	2	3	1	25	.5	15	3	99.5
1975	N	3,075	2,622	5,697	651	942	152	277	76	2,098	58	1,456	290	9,596
	%	32	27	59	7	10	1	3	1	22	.6	15	3	99.6
Percentage screened out by standard	%	21	16	19	35	33	38	34	28	31	0	24	28	24
Model B	N	3,211	2,673	5,884	624	460	145	246	69	1,544	54	1,511	250	9,243
	%	35	29	64	7	5	1	3	1	17	.6	16	3	99.6
Percentage screened out by standard	%	18	15	17	37	67	41	41	35	51	7	21	38	27
Model C	N	3,119	2,591	5,710	503	334	119	206	61	1,223	54	1,377	224	8,588
	%	36	30	66	6	4	1	2	1	14	.6	16	3	99.6
Percentage screened out by standard	%	20	18	19	50	76	51	51	42	61	7	28	44	32
1975 & Model B	N	2,630	2,319	4,949	461	376	108	179	59	1,183	54	1,212	204	7,602
	%	34	31	65	6	5	1	2	.8	15	.7	16	3	99.5
Percentage screened out by standard	%	33	26	30	54	73	56	57	44	63	7	37	49	40
1975 & Model C	N	2,556	2,241	4,797	366	271	93	153	55	938	54	,118	179	7,086
	%	36	32	68	5	4	1	2	.8	13	.8	16	2	99.6
Percentage screened out by standard	%	35	29	32	63	81	62	64	48	70	7	42	55	44

Table 7. **Effect of Enlistment Standard on Quality Indicators**

Enlistment Standard	N	Mechanical AI		Administrative AI		General AI		Electronics AI		AFQT		Years of Education	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1972 standard	12,599	59.24	20.24	57.02	20.66	62.20	17.97	62.17	20.04	61.14	19.81	11.95	.92
1975 standard	9,596	64.54	18.08	62.92	18.22	68.54	14.52	68.38	17.23	66.47	18.60	12.11	.85
Model B	9,243	61.59	20.09	59.48	20.61	64.23	18.32	64.97	19.66	62.86	19.97	12.15	.79
Model C	8,588	61.76	20.22	59.61	20.64	64.43	18.31	65.12	19.71	63.04	19.98	12.16	.81
1975 and Model B	7,602	65.83	18.01	64.26	18.33	69.64	14.69	69.85	17.09	67.06	18.73	12.21	.81
1975 and Model C	7,086	65.98	18.13	64.34	18.34	69.79	14.69	69.95	17.16	67.17	18.76	12.22	.83

Table 8. **Percentage Qualified by Enlistment Standard by Race**

Enlistment Standard		Qualified by Standard			
		Black	White	Other	Total
1972 standard	N	1,516	10,963	120	12,599
	%	12	87	1	100
1975 standard	N	791	8,727	78	9,596
	%	8	91	1	100
Model B	N	1,162	7,987	94	9,243
	%	13	86	1	100
Model C	N	972	7,521	95	8,588
	%	11	86	1	100
1975 and Model B	N	666	6,867	69	7,602
	%	9	90	1	100
1975 and Model C	N	568	6,451	67	7,086
	%	8	91	1	100

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APPENDIX A: DESCRIPTIVE STATISTICS

Table A1. **Descriptive Statistics on 1972 Sample Population**

Index		Category: Eligible to Reenlist		Ineligible to Reenlist					Reenl Elig Indeterminate			Total
		Active Duty	Normal Separations	Loss, Marg Prod	Loss, Disqual for Retn	Loss, Unfitness	Loss, Unsuitability	Loss, Misc Undes	Loss, Officer Program	Loss, Desir Indetm	Loss, Phys Reasons	
	N	3,916	3,142	998	1,398	245	420	106	58	1,915	401	12,599
Aptitude												
Mechanical AI	$\bar{X}$	59.64	62.39	54.83	55.90	53.29	55.77	59.76	79.91	59.49	56.31	59.24
	SD	20.21	19.98	20.24	19.98	19.02	19.76	20.64	14.55	20.10	19.28	20.24
Administrative AI	$\bar{X}$	57.67	60.33	51.53	53.70	50.33	53.53	58.07	80.00	56.86	54.93	57.02
	SD	20.36	20.65	19.76	20.55	20.54	19.07	22.09	14.23	20.66	20.44	20.66
General AI	$\bar{X}$	62.40	65.49	57.80	59.46	56.98	58.63	64.10	83.62	61.85	60.01	62.20
	SD	18.32	17.93	16.42	16.72	16.64	17.03	19.28	11.59	18.11	16.96	17.97
Electronics AI	$\bar{X}$	62.99	65.83	56.68	58.32	55.90	57.52	62.74	83.88	61.94	59.17	62.17
	SD	19.79	19.88	19.74	19.41	19.64	19.28	22.38	14.50	19.83	15.54	20.04
AFQT	$\bar{X}$	61.25	63.72	56.77	59.35	56.06	57.55	61.41	79.60	61.73	58.43	61.14
	SD	20.19	19.59	18.97	19.42	18.35	19.23	21.41	18.54	19.30	19.52	19.81
Education												
Years of Education	$\bar{X}$	12.03	12.13	11.68	11.60	11.54	11.69	11.80	13.78	11.96	11.92	11.95
	SD	.81	.92	.78	1.08	1.00	.87	1.01	1.89	.84	.91	.92
Age												
Age (Years) at Enlistment	$\bar{X}$	19.39	19.40	18.89	19.27	18.98	19.06	19.25	20.42	19.27	19.53	19.31
	SD	1.51	1.43	1.18	1.50	1.30	1.32	1.73	2.20	1.40	1.85	1.47

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